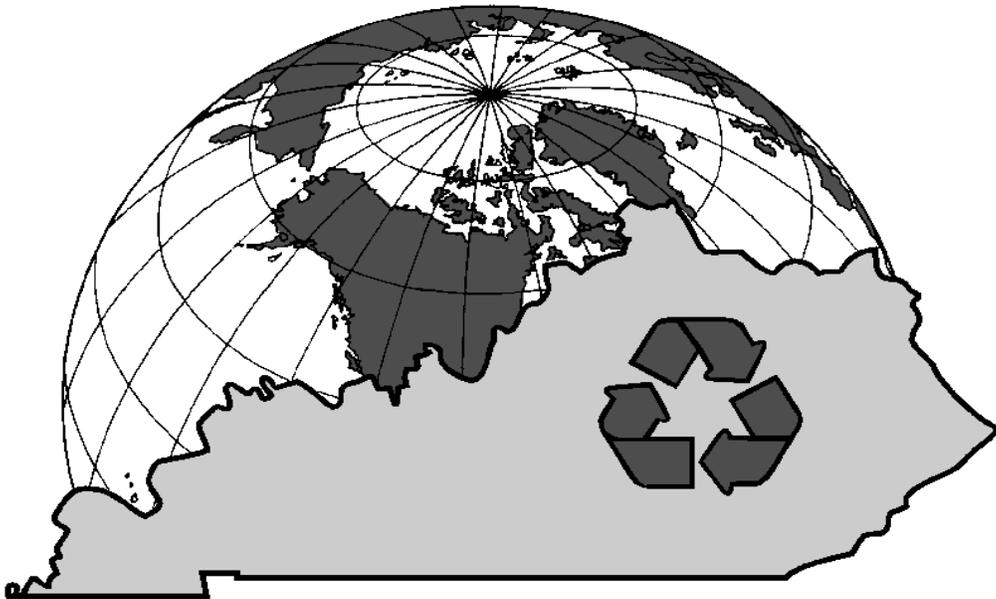


# COMMUNITY RECYCLING

## A Manual for Planning and Operating a Recycling Center



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Energy and Environment Cabinet

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## SECTION 1

# THE CONCEPT OF RECYCLING

Recycling is a process, and not merely the collection of materials. The recycling process involves a series of steps from the point of purchase, through the use, and finally to the recovery of an item that has served its original purpose. Recovered items are then processed and returned to the economic mainstream in the form of a raw material to be manufactured into new products.

The collection of materials is the part of the recycling process in which communities and the local citizenry have the most interest. This part of the process, however, will require a sufficient accumulation of material to achieve an economy of scale. Stated another way, tractor-trailer load lots are necessary to attract the best markets for the recovered materials.

Most urban areas in Kentucky have a sufficient population base to support programs. However, in rural Kentucky it is more difficult to accumulate larger quantities of the same material to achieve an economy of scale. Small operations with processing capabilities may find it advantageous to market cooperatively or regionalize with other programs to access better market values for materials.

## FIVE COMPONENTS OF A RECYCLING PROGRAM

1. **MARKETS:** The best markets for materials normally collected in municipal programs are for those packaged and sold in tractor-trailer lots. Combination loads of several materials are marketable as well, but usually at lower pricing. Information about markets is available on the Resource Conservation web site <http://www.waste.ky.gov/branches/rla/Recycling+Assistance+Section.htm>.
2. **MATERIALS:** There are several materials in the waste stream worth collecting and processing. There are an estimated 20 pounds of these materials available in the waste stream for every man, woman and child in Kentucky. Section 6 "Feedstock Quality Control of recyclable Materials" identifies the more common recyclable materials and provides some general quality standards for them.
3. **COLLECTION SYSTEM:** A collection system will be necessary to accumulate the recovered materials. The system utilized will usually be designed around the existing system used for the collection of waste (trash/garbage). See Section 3 entitled

“Collecting Recyclables.”

4. **PROCESSING CENTER:** For materials to be marketable, they must be processed to meet quality and shipping standards established by the buyer. Old Corrugated Containers (OCC) must be baled and be free of contaminants: aluminum cans may have to be flattened, densified or baled, and must be free of steel and other contaminants; glass must usually be separated by color; steel cans and plastic must be baled. A processing center, whether publicly or privately owned, is necessary. The equipment needed and the layout of the facility will depend on the collection system, the quantities and variety of material, and the methods of processing (co-mingled or source separated). Equipment and estimated costs are given on page 19, the “Processing Center” sheet.
  
5. **ORGANIZATIONAL STRUCTURE:** Some organizational structure is necessary to conduct the day-to-day operations of the program, schedule deliveries, ship materials, receive revenue, pay bills and enter into contracts. Developing a thoughtful & effective business plan is essential before investing, collecting, and/or purchasing processing equipment.



## SECTION 2

# OUTLINE OF A RECYCLING PROGRAM

### **Organize**

- Appoint a coordinator
- Organize committees
  1. Markets
  2. Collection
  3. Organization

### **Understand What Recycling Can Do**

- Economic benefits
  - Savings – collection, disposal cost avoidance, transportation
  - Revenues from sale of materials
  - Creation of jobs (processing & manufacturing)

### **Evaluate The Present Situation**

- Waste & recycling collectors
- Disposal site-transfer station, landfill, hauled out of county
- Volume collected in tons
- Type of materials (business, industry, residential, seasonal)
- Equipment available for collection of recyclables
- Facilities available for processing recyclable materials

### **Markets**

- Location
  - Market Opportunities for Recyclable Materials Recovered in Kentucky* from the Kentucky Recycling Market Assistance Program (KRMA)
  - Other counties
  - Area recyclers
  - Yellow pages
- Match materials with markets by determining the total quality standards for materials and packaging required (also known as “the pack” in paper dealer terms)

### **Collection**

- Drop-off (municipal or volunteer) and convenience centers
  - Advantages
    - Low capital investment & operating costs
    - Greater range of collection
    - Hours can vary
    - Clean materials if staffed w/limited access (fenced & locked)

### **Disadvantages**

- Lower recovery rate-relies on residents delivering
- Vulnerable to theft and vandalism
- Can become unsightly
- Contaminated materials-if unmanned (to be effective drop offs must be manned and access controlled in an enclosed, fenced area.)

### **Curbside Collection**

#### Advantages

- Convenient to homeowner
- Highest recovery and participation rates
- Can combine with regular trash collection

#### Disadvantages

- High initial capital & operating costs
- Complex management

### **Mobile Unit**

#### Advantages

- Flexibility of location
- Low capital investment

#### Disadvantages

- Limited materials
- Limited hours
- Contamination if un-manned

#### Equipment

- Determined by type of program

#### Sources:

- Division of Waste Management (KRMA)*
- Other community programs*
- Trade journals*
- Yellow pages*

### **Regional Approach**

Contact adjoining counties or neighboring programs

Benefits of regional approach:

- Recyclables may be upgraded & processed to meet best market quality standards
- Larger volumes provide market leverage
- Lower municipal processing and transportation equipment costs
- Lower municipal administrative costs
- Markets more willing to negotiate with large suppliers



## **SECTION 3**

# **COLLECTING RECYCLABLES**

## **INTEGRATING DOOR-TO-DOOR RECYCLABLES COLLECTION WITH OTHER RECYCLING AND WASTE COLLECTION ACTIVITIES\***

Successful implementation of a door-to-door recyclables collection program requires that the program be sensitive and responsive to existing related activities, services and organizations.

### **COORDINATING WITH GARBAGE COLLECTION SERVICES**

The cost of a door-to-door collection program can be greatly reduced by integrating it with an existing refuse collection system. Savings realized by reductions in the costs required to collect and dispose of remaining solid waste after removal of recyclables can help to offset the cost of the door-to-door collection program for recyclables. However, this is possible only if the same hauler is providing collection services for both refuse and recyclables or if a mechanism is established for recovering credits from the refuse hauler or haulers. The contractual method used to provide refuse collection services to residences influences a community's ability to capture these avoided collection and disposal costs.

### **COMMUNITIES WITH UNRESTRICTED MULTIPLE HAULERS**

In some communities, each homeowner has the responsibility of making arrangements for trash pickup with a hauler of the resident's choice. In such a situation, several different haulers will typically serve neighbors along a given street, and collection days will also vary. These circumstances increase the difficulty of initiating an efficient community-wide program for the door-to-door collection of recyclables. The principal implementation options for communities where multiple haulers have overlapping service areas include the following:

#### **REQUIRE MUNICIPAL HAULING LICENSES**

A municipality or county can mandate that haulers provide door-to-door collection of a specified list of recyclables at a minimum frequency. With this type of requirement, the hauler can conduct the recyclables collection or contract with another company to provide this service as long as each customer served is offered door-to-door collection of

recyclables. Competition will dictate the costs to the customer. Because this type of system does not require changes in service areas, it allows small haulers to continue to operate and incorporates the benefits of integrating garbage and recyclables collection.

### **MAINTAIN EXISTING REFUSE SYSTEM AND CONTRACT WITH AN INDEPENDENT RECYCLING CONTRACTOR**

Depending on the size of a community, one zone or many zones can be designated. With this type of system, it may be necessary to negotiate a means of crediting community residents with savings that the individual refuse haulers will realize in the cost of collection and disposal of remaining wastes.

### **USE ONE OR SEVERAL HAULERS FOR COMBINED REFUSE AND RECYCABLES COLLECTION**

The number of haulers desired depends on the size of the community and the rates the haulers can offer. This system would allow for the benefits of combined collection of recyclables and remaining waste. With this type of system, the size of the zones could be set at a scale that would enable smaller, existing haulers to bid for one or more zones.

### **COMMUNITIES WITH SOLE HAULERS OR SOLE HAULERS BY NEIGHBORHOOD**

Some municipalities bid and contract waste collection services for their residents through one contract for the entire community or through multiple contracts, each for an individual zone within the community. Under this arrangement, the integration of refuse and recyclable collections is more straightforward because the municipality can stipulate in its bidding documents the recyclable collection services that must be provided by the refuse hauler. Avoided collection and disposal costs realized by the refuse hauler are automatically included in the bid prices offered for the combined services. However, short-term difficulties may be encountered if an existing contract for refuse collection does not expire before the selected date for starting the door-to-door collection program. In this situation, the municipality should negotiate with the refuse hauler to capture credits for avoided collection and disposal costs.

### **COORDINATING WITH EXISTING RECYCLING OPERATIONS**

A search should be conducted before a recyclable material collection program is initiated in a community, to determine if there already may be an existing network of recycling programs and activities. Usually this network includes an assortment of public, private, and not-for-profit interests, encompassing such parties as environmental organizations, scrap dealers, church groups, resale stores (for example, Goodwill Industries, Disabled American Veterans – DAV, and the Salvation Army), and others. Some of these groups may feel threatened by the initiation of a community recyclables collection program because of real or perceived impacts of the program on their operations. It is important that, to the extent possible, a recyclables collection program be coordinated with these parties so that the community's overall waste reduction efforts can build on the success and momentum of existing activities.

A new door-to-door recycling program can positively coexist with existing recycling

programs such as drop-off and buy-back operations. Usually, door-to-door and other programs are not in direct competition with each other because the persons who are participating in the existing programs will usually continue to do so. Likewise, persons who participate in buy-back programs because of the financial incentive will also most likely continue to do so. However, inefficient, inconvenient recycling programs will possibly lose participants if a convenient door-to-door program is implemented.

The best advice in coordinating with existing recycling operations is to invite the parties into the planning process as much as possible. Where conflicts exist work toward solutions that lead to the maximum waste diversion for the community as a whole. Try to find ways in which efforts by various parties can be made to compliment each other. For example, some curbside collection programs have worked with charitable organizations such as those mentioned to establish regular pickup days on which residents can set out articles such as used clothing that is picked up by a truck following the recyclables collection vehicle. This type of collection strategy could also be used for other items such as scrap metals and large appliances (called white goods).

Although it is important to establish a linkage between programs, it is also important to prevent scavenging of materials that are set out for collection. All effective recyclables collection programs will target materials that comprise a significant portion of the waste stream, most of which have a relatively low market value. In an efficient program, the cost of collecting and processing low-value materials will be somewhat offset through the collection of high-value materials such as aluminum cans. If scavengers are allowed to remove these high-value materials from the program, the program's ability to minimize costs and become self-sufficient may be undermined. Therefore, most communities that implement door-to-door recyclables collection programs adopt an anti-scavenging ordinance that prohibits unauthorized removal of set out materials.

## **COORDINATION WITH DROP-OFF PROGRAMS**

Many communities have found the increased public awareness and involvement created by a good door-to-door collection program actually increases the amounts of materials delivered to drop-off facilities already in place. A brief discussion of several strategies for supplementing a door-to-door collection program with a drop-off program follows:

- › **Drop-Off Programs Can Be Used to Collect Materials Not Included in a Door-to-Door Program** While it is desirable to offer residents the opportunity to recycle as many materials as possible, door-to-door collection is often not the most economical method for collecting certain materials. Materials often selected for collection through drop-off programs rather than door-to-door collection include motor oil, tires, batteries (household and lead-acid), white goods, scrap metal, corrugated containers, office paper, and various types of plastic. Sometimes, drop-off programs are also used to establish an exchange location for articles such as used clothing, furniture, and toys.
- › **Drop-Off Programs Can Be Used to Serve Residents Not Included in Door-to-Door Collection Programs** Recycling program officials may decide that it is more cost-effective to provide recycling services to some residents via drop-off facilities

than through door-to-door collection. For example, in counties with a wide range of population densities, recycling officials may choose to serve urban and suburban areas with a door-to-door collection program while strategically placing drop-off facilities in rural areas for maximum accessibility. Similarly, a community may elect to use drop-off facilities to serve residents of mid-size and high-rise multifamily housing.

- ▶ **Drop-Off Programs Can Provide an Additional Opportunity for Recycling** Drop-off recycling programs provide residents with recycling opportunities in addition to door-to-door collection. This is particularly important if a program's collection frequency is bi-weekly or perhaps even monthly, thereby increasing recyclables storage requirements. Long intervals between pickups may discourage participation by people who do not have the needed storage space. Drop-off locations would be essential, for example, in a program that only collects recyclables on a monthly basis.

Implementing a door-to-door recyclables collection program will affect the types of remaining materials that are delivered to drop-off facilities, and these changes can affect the costs and revenues of the drop-off program. For example, aluminum beverage containers usually provide the largest revenues to recycling programs. Aluminum can collection in the door-to-door collection program will divert this valuable material from existing drop-off facilities. Also, other, less valuable materials not collected in the door-to-door collection program are often separated by residents and delivered to drop-off facilities, thus increasing the drop-off facility's net operating costs. Therefore, recycling program planning needs to ensure that funding for both the door-to-door and drop-off elements of the recycling program are properly integrated to sustain the viability of both.

\*Adapted and reprinted in part from: Integrated Collection System: Developing and implementing a Coordinated Strategy by: Wayne P. Pferdehirt, P.E., AICP, UW-Solid and Hazardous Waste Education Center, Madison, Wisconsin



## SECTION 4

# QUESTIONS TO ASK POTENTIAL BUYERS OF RECYCABLES

When meeting with recycling companies interested in purchasing your collected materials, there are a number of issues you should discuss, including:

- › **What types of recyclables will the company accept and how must they be prepared?** Recycling companies might request that the material be baled, compacted, shredded, granulated, or loose. Generally, recyclers will offer a better price for compacted or baled material. Compacting or densifying materials before transporting also can be a cost-effective method of lowering hauling costs for the buyer.
- › **What contract terms will the buyer require?** Discuss the length of the potential contract with the buyer. Shorter contracts provide greater flexibility to take advantage of rising prices, while longer contracts provide more security in an unsteady market. Often, buyers favor long-term contracts to help ensure a consistent supply of materials. The term of payment should be discussed as well, since some buyers pay after delivery of each load, while others set up a periodic schedule. Also, ask whether the buyer would be willing to allow mutually agreed on changes to the contract over time. The buyer might want some flexibility as well; in many cases, the buyer will be willing to pay a higher rate in return for a stable supply of quality materials. Ask for a monthly purchase order.
- › **Who provides transportation?** If the buyer does not provide transportation services, you will need to locate a hauler to transport materials to the buyer. The Yellow Pages, local waste haulers, and state or local waste management authorities can help provide this information.
- › **What is the schedule of collections?** If the recycling company offers to provide transportation, check on the frequency of collections. Some businesses might prefer to have the hauler be on call, picking up recyclables when a certain weight or volume has been reached. Larger companies might generate enough recyclable material to warrant a set schedule of collections.
- › **What are the maximum allowable contaminant levels and what is the procedure for dealing with rejected loads?** Inquire what the buyer has established as maximum allowable levels for contaminants. If these requirements are not met, the buyer might reject a contaminated load and send it back to your company. The buyer also might dispose of a contaminated load in a landfill or combustor, which can result in your company incurring additional cost. Get the grade standards in writing.
- › **Are there minimum quantity requirements?** Find out whether the buyer requires a minimum weight or volume before accepting delivery. If a buyer's minimum quantity requirements are difficult to meet, consider working with neighboring organizations. By working together, it might be possible to collect recyclables in

central storage containers and thereby meet the buyer's requirements.

- › **Where will the materials be weighed?** Ask where the material will be weighed, and if copies of the weight slips will be available. Weighing the material yourself before it is transported will eliminate the problem of lost weight slips and confirm the accuracy of the weight recorded by the buyer. In short, have your own scales.
- › **Who will provide containers for recyclables?** Buyers should be asked whether they will provide containers in which to collect, store, and transport the material, and whether there is a fee for this service.
- › **Can “escape clauses” be included in the contract?** Such clauses establish the right of a company to be released from the terms of the contract under conditions of noncompliance by the buyer.
- › **Be sure to check references!** Obtain and thoroughly check the buyer's references with existing contract holders, asking these companies specifically whether their buyer is fulfilling all contract specifications.

### **CONTRACT VS. OPEN MARKET**

Secondary materials are usually sold either on the open or “spot” market or through some type of contract arrangement. On the open market, decision makers must locate a buyer each time enough material has been accumulated to be sold. By selling materials in this manner, the community can get the best price for the materials at the time. When the markets are down, however, the community may be faced with low prices or no buyers at all. With a contract, a deal is made between the community and a broker or end-user involving the delivery of a certain amount of material at a certain price for a specified amount of time. A contract helps protect the community from market fluctuations and ensures an outlet for materials. The agreed price, however, may end up below the actual market price for the material. Ask for a **monthly purchase order** for the coming month to insure quantity you are allowed to ship as well as the prices paid during that period.

When possible, many decision makers choose to develop contracts with buyers, mainly because it reduces the risk of having no outlet for materials. Post-consumer materials markets fluctuate greatly, and many programs are not equipped to handle flat markets (for example, material may have to be stored or sent to a landfill if no buyers are available). A contract will guarantee a buyer for a specific amount of time.

### **STOCKPILING**

Because post-consumer materials markets fluctuate so greatly, recycling programs may be faced with no outlet for materials during down markets. In anticipation of this, many successful recycling programs are prepared to stockpile materials until markets become available (or for as long as it is practical). Sufficient storage room must be available to store stacks of baled material for several months if necessary. Programs designed with no stockpiling capacity may have to dispose of the collected materials.



## **SECTION 5**

# **FACILITY DESIGN AND OPERATION**

# OPERATIONAL CONSIDERATIONS

This section is intended to provide an understanding of the technical aspects associated with the planning, design and operation of a processing facility, often called a Materials Recovery Facility (MRF-pronounced “murf”). Although processing adds value to the commodities and allows for greater storage potential, the community does not have to do anything but collect recyclable commodities if buyers for loose materials can be located. However, processing at least some materials can greatly enhance a community-recycling program. For other materials, such as used oil, batteries, tires and white goods, storage may be the primary role of the community. For these materials, specific requirements are given in the following commodity sections.

Most MRF’s typically process the following group of commodities:

- › Plastic containers
- › Aluminum cans
- › Steel cans
- › Glass containers
- › Newsprint
- › High grade and/or mixed paper
- › Corrugated cardboard

Although these are the most common commodities, you do not have to limit your program to only these materials. Processing requirements will be only one of the factors in determining which commodities to deal with. **You should not reinvent the wheel.** However, you should be creative.

The information presented in this section addresses the following fundamental topics for processing the typically recycled commodities listed above.

- › Preliminary Planning
- › Facility Space Requirements
- › MRF Equipment Guidelines

Information about equipment, buildings, and further guidance for processing any type of recyclable commodity are given at the end of this section and in the Appendix.

## PRELIMINARY PLANNING

Before a MRF can be designed, implemented, and successfully operated, the community must determine which recyclable commodities will be recovered, and how to handle the material upon arrival at the facility.

During the early planning stages, a realistic approach should be taken when determining the specific materials that will be processed through the facility. This preliminary choice

of materials will have a direct impact on dictating the design and configuration of the MRF's overall floor plan and equipment selection. Attempting to process too many kinds of material can quickly overwhelm and complicate operations. A good starting point in making this decision is to focus on materials that best satisfy the following criteria:

- › The handling and processing of the material should not subject workers to increased hazards or jeopardize safety or code compliance at the facility. (Although recycling facilities have not generally come under the same direct standards as other manufacturers and processing facilities, you need to check with your appropriate state agency for code compliance information.)
- › The material should have physical properties that readily allow for compaction or volume reduction techniques to be applied at the facility. (Except for newspaper and office paper due to their high volumes and good dollar values.)
- › The costs and level of effort required for collecting/receiving, processing and storage of the material should not exceed the average market value of the material.
- › There must be a ready buyer for the commodities.

### **FACILITY SPACE REQUIREMENTS**

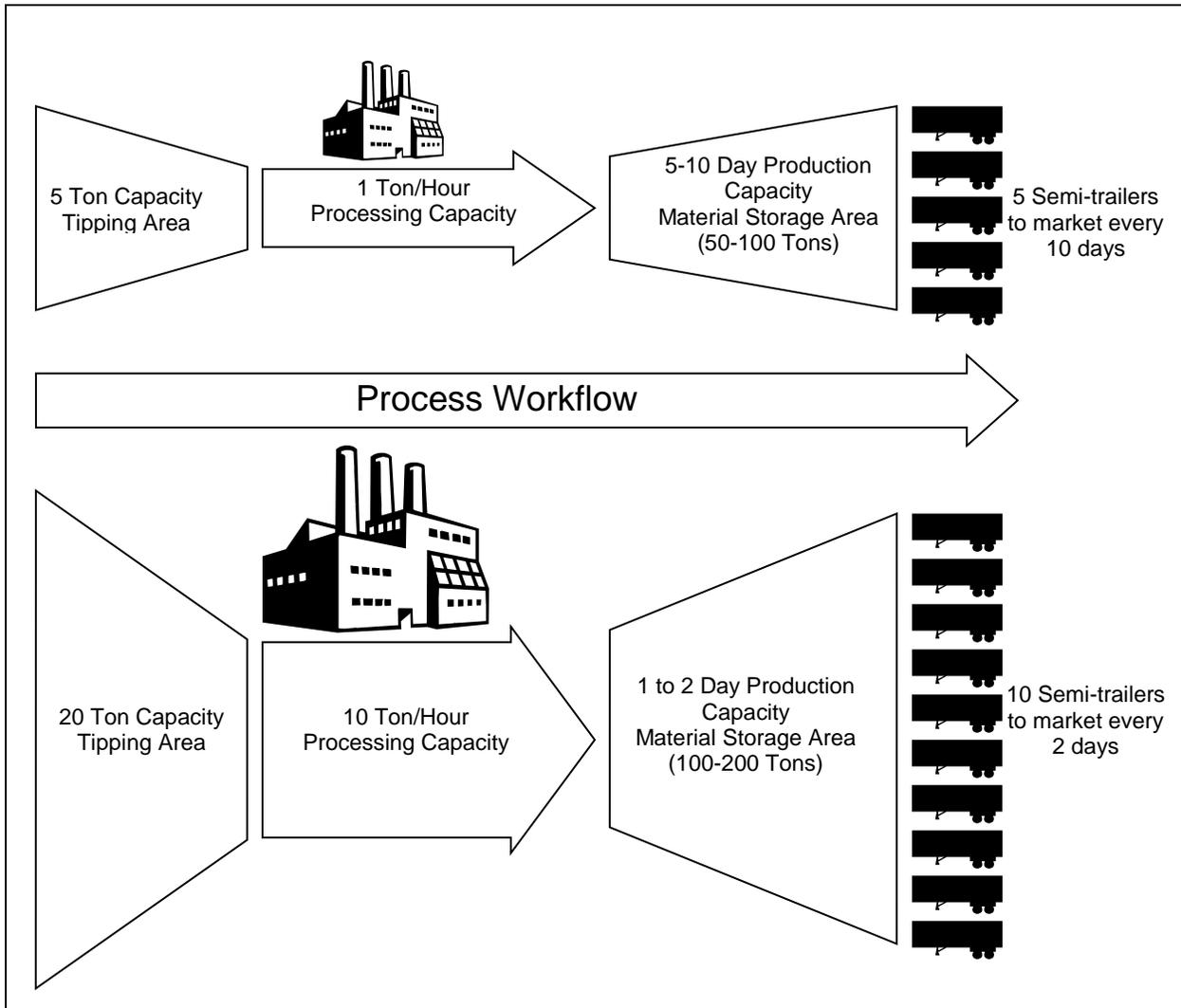
The previous paragraphs provide some insight into the selection of which materials to process. This section begins to illustrate how existing, well-run MRFs handle and process a variety of commonly recycled commodities.

The configurations and floor plans of existing MRFs differ greatly from one facility to another in many ways. Yet there is something nearly all of the numerous designs have in common – three distinct and separate working areas:

- › There typically is a receiving or tipping area where materials are transferred from the arriving collection vehicles to receiving bins or dedicated floor space.
- › There must be a sorting or processing area where materials are separated by type or, if already separated at the source, at least inspected for contaminants before being readied for transport to the markets.
- › There must be an area for temporary short-term storage of the ready materials prior to shipment.

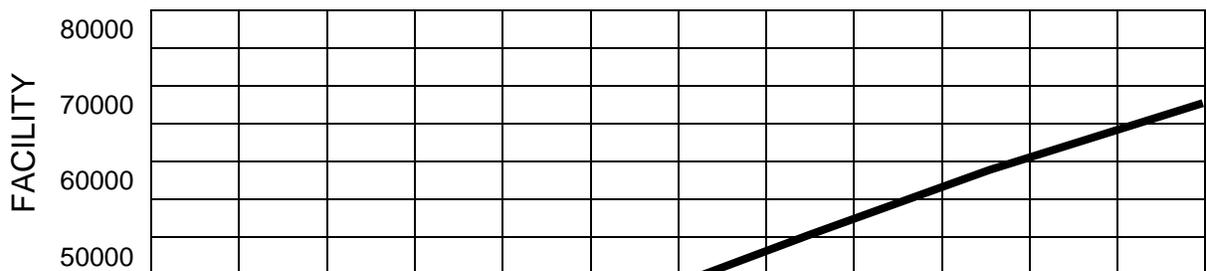
In analyzing the processing capacity of a given floor area or in determining the required floor area for a desired daily throughput, the designer must first recognize that calculations for a 10 ton-per-day (TPD) facility are not directly proportional to those for a 100 TPD facility. That is to say, a 100 TPD operation will not simply be 10 times larger than a 10 TPD operation. The reasons for this are readily apparent once the size relationships between the three fundamental working areas found in almost all MRF's are understood. The following simplified diagram illustrates and compares the relative size of these working areas in two facilities with substantially different daily production capacities.

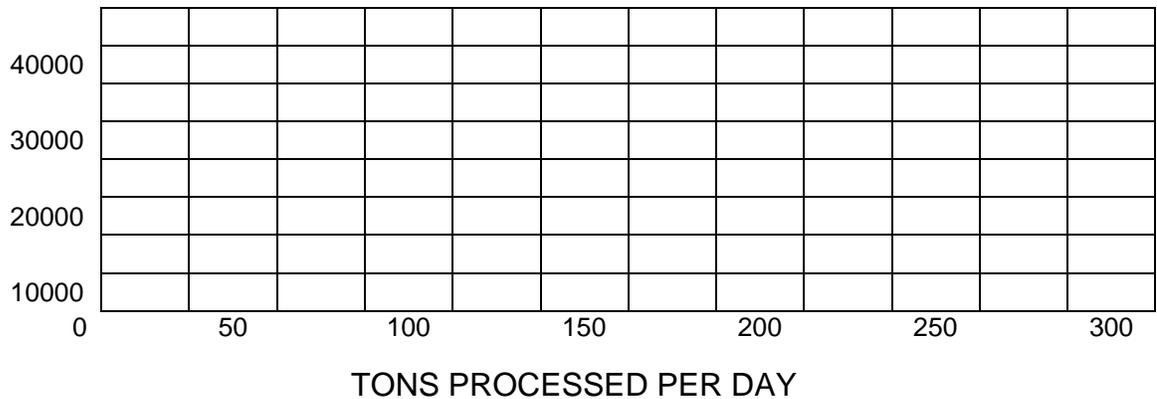
## COMPARISON OF A 10 TPD AND 100 TPD FACILITY



The following chart shows the normal floor space requirements for material recovery facilities processing from less than 10 TPD through 300 TPD. Although many MRFs in the United States operate within building areas that are significantly larger or smaller for their respective daily throughput levels, the figures shown closely reflect the industry averages.

### TYPICAL FLOOR SPACE VS. TONS PROCESSED PER DAY





In this example the overall area of the 100 TPD facility is obviously larger than the 10 TPD facility, but not by more than a multiple of 3. This floor space comparison is fairly representative because of the fact that larger operations process materials at greater hourly volumes. They also ship ready materials to buyers in the marketplace more frequently. Both of these factors act jointly to lessen the floor space requirements in the tipping and storage areas of the larger facilities. This multiplier becomes an even smaller number when, for example, a typical 100 TPD facility is compared to a typical 300 TPD facility.

### EQUIPMENT NEEDS

Contemporary MRFs generally receive recyclable materials in one of two basic forms, either **commingled** or **source-separated**. When materials are commingled they are typically received in bulk loads of the two following categories.

- **Commingled containers:**
  - Plastics
  - Glass
  - Aluminum Cans
  - Steel Cans
  
- **Commingled paper products:**
  - Cardboard
  - Newsprint
  - Magazines
  - High Grade Papers
  - Paperboard
  - “Junk” mail

Because of the very different physical properties of the materials in these two basic groups, most recovery facilities will handle them using separate processing lines. A large number of material recovery operations with daily production levels of less than 50 tons utilize predominantly manual sorting methods to separate, inspect, and classify these recyclable materials. This work is usually done along three to four foot wide sorting conveyors that move the various materials to the sorting personnel at a waist-high level. The workers are then able to classify and place their assigned material(s) into nearby storage bins from a standing position. Depending on the volumes involved, these sorting lines are sometimes constructed just above the main floor level or they may be part of an

elevated platform, allowing large gravity-fed material bins to be positioned under the structure. In either situation a front-end loader typically moves the incoming materials from the tipping floor to the in-feed hopper of an inclined conveyor leading to the sorting positions. As an initial step in sorting and processing, steel cans and other ferrous metal can be magnetically separated from the other commingled containers.

Smaller facilities usually have only one sorting conveyor/platform and will process containers for some portions of the operating day and papers or cardboard during others. More & more facilities attempt to mix or process the two categories as one stream, called single stream collection. It has been shown to increase volumes collected, but also reduced volumes and quality of recyclable materials sold due to cross contamination from being commingled.

Following the sorting and classification operations, the grouped materials will need to be prepared for shipment to the various buyers in the marketplace. The methodology and equipment used to process the individual recyclables varies from one facility to the next and is generally dictated by the requirements of the buyers. Specifications and quality control guidelines that mandate the size, shape, and weight limitations of the delivered materials are routinely made part of most purchase agreements. In order to meet these specifications, some of the more commonly recycled materials are processed as indicated below:

- › **Plastic, steel and aluminum** are typically:
  - Baled, (preferred method)
  - Flattened
  - Shredded, or
  - Shipped loose with minimal or no volume reduction
- › **Glass containers** are typically:
  - Shipped whole or semi-broken,
  - Crushed into small chips called cullet
  - Shipped by individual color or as mixed colors
  - Pulverized, commingled colors for local road bed use (preferred method)
- › **Cardboard and papers** are typically:
  - Baled as whole or shredded sheets (preferred method), or
  - Shipped loose in “Gaylord” type boxes or trailers.

The following individual commodity sections give more detailed information concerning specific processing requirements for different materials. Brief descriptions of some of the material separating equipment and size-reduction equipment employed at many existing MRFs are given below.

## **TROMMEL SCREENS**

These are devices that incorporate a rotating perforated drum as their main component. The perforations or drilled holes incrementally increase in size along the length of the cylinder, allowing smaller materials to drop out early in the process. Larger items are carried further along as the rotation continues, dropping through openings of increasing

diameter as their size permits. Items too large for any of the openings pass through the trommel and can be moved to various areas by a conveyor or other means.

## VIBRATORY SCREENS

This equipment consists of a perforated steel plate or large diameter wire mesh screen mounted within a steel box frame and positioned at a slant angle off horizontal. The screen and frame are typically mounted on springs with vibratory motion induced by an electric motor driving an eccentric flywheel. These types of screens are sometimes used to accomplish the same results as a trommel screen, but more often are used to simply screen off fine grit and broken glass from the recyclables.

## MATERIAL BALERS

Balers produce densified bales of a number of different compressible materials. These machines are powered by electric motors that drive hydraulic systems used to compact material into bales of various sizes. Most of the recovered containers and paper products can be baled successfully for transport to the marketplace. The three basic types or designs of balers, listed from least expensive to most expensive are:

- › **Vertical balers**: This type of low-density baler is often used to bale cardboard at supermarket receiving areas. The design makes it suitable for small volume operations where only a few bales need to be produced each day. Bales formed in vertical balers need to be tied manually with wire straps before the bale is fully released from the baling chamber. Machines of this type with long cylinder rods (long stroke) are capable of baling more materials than standard models.
- › **Horizontal (single ram) balers**: This medium-density baler design uses one medium to large bore hydraulic ram to both form the bale and to eject the bale from the machine. This design is sometimes referred to as an open-end baler because the bale is formed within an open-ended tapering baling chamber. This type of baler allows bales to be formed in an almost sausage-like fashion. The length of the finished bales can be varied and controlled as dictated by the material being baled or the buyer's specifications. A similar horizontal baler design is manufactured having a hinged bale door blocking the normally open end of the machine. This design loses the ability to vary the length of the bales produced and is limited to somewhat slower production rates. Automatic and manual wire strapping options are available for horizontal bales.
- › **Two ram balers**: Balers of this type include a second hydraulic ram, positioned perpendicularly to the main baling ram, which is used to eject the finished bale from the machine. The design of this baler allows the baling ram to compress materials against the heavy steel sidewall of the baling chamber, producing high-density bales. Other variations of this design include a bale door that lowers in guillotine-like fashion to fully enclose the baling chamber during formation of the bales. Two-ram balers are usually fitted with an automatic wire tying apparatus that applies wire strapping to the bale as it is ejected from the baler. Facilities with high daily production volumes use one or more of this type of baler to quickly bale paper products and containers for transport to the market place. Many of these machines are capable of baling 25

to 30 or more tons of material per hour.

- › **Can densifiers:** Densifiers are really a variety of small balers that compress and shape aluminum cans into “biscuits” that weigh roughly 20-40 pounds each. Unique form given to the biscuits by some densifiers allows them to be interlocked to form a palletized load, meeting the specific requirements of the aluminum products industry.

### **CAN FLATTENERS AND FLATTENER/BLOWERS**

These devices achieve the results that their nomenclatures suggest. They are relatively small machines which generally weigh several hundred pounds and have a footprint of approximately 5’x10’. A flattener is typically used to reduce the volume of cans being loaded into a container such as a roll-off box or van trailer for transport. Flattener/blowers allow a directionally adjustable spout to blow flattened cans into a semi-trailer for transport.

Similar equipment, such as GLASS CRUSHERS, PLASTICS PERFORATORS, GRANULATORS and MATERIAL SHREDDERS are also available for volume reduction and to facilitate economical transport of these recyclable commodities.

### **EXISTING FACILITY TOURS**

During the planning and preliminary design phases of your MRF development program, it will be very beneficial to visit and tour existing recycling facilities. You should tour facilities that are processing the various materials you are considering and at similar daily volumes.

The effort and time spent at these facilities will provide creative insight and valuable knowledge into the realities of planning and operating an efficient and cost-effective material recovery facility. The KRMA staff can direct you to recycling facilities in your area.

### **PROCESSING CENTER**

- › Building: Minimum 8,000 sq. ft. with 18-20 ft. ceiling, dock access and 220v 3-phase service
- › Storage: Covered shed space, concrete pads for glass, and dock space

Cost of equipment for a recycling center will be determined by the volume of material to be processed. The following cost figures are for informational purposes only. They are estimated to satisfy the requirements for a population base of approximately 80,000 people with an average 50% participation rate. Smaller programs may be able to find less expensive equipment with a smaller capacity to satisfy their needs.

### **ESTIMATED COSTS**

<b>Equipment</b>	<b>Low</b>	<b>High</b>
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Horizontal Baling System <sup>1</sup>	\$80,000	\$130,000
Can Separator	\$ 5,000	\$ 7,500
Bucket Loader	\$18,000	\$23,000
Material Handling Equipment <sup>2</sup>	\$12,000	\$15,000
Fork Lift	\$20,000	\$25,000
Large Sorting Conveyor	\$20,000	\$30,000
Small Sorting Conveyor	\$10,000	\$15,000
Scale	\$ 3,500	\$ 7,500
Pallet Jack	\$ 500	\$ 1,000
Dock Plate	\$ 1,200	\$ 3,500
<b>TOTAL</b>	<b>\$170,200</b>	<b>\$257,500</b>

(All of the above equipment can be found used /rebuilt at reduced prices.)

<sup>1</sup>Down stroke balers can be purchased in a range of \$8,000 - \$16,000. HOWEVER, it will have a limited capability, capacity, and generally be more labor intensive to operate.

<sup>2</sup> Includes “roller buggies”, Gaylord type boxes, cage type containers, and barrier blocks for constructing loose materials bunkers



## SECTION 6

# FEEDSTOCK QUALITY CONTROL OF RECYCLABLE MATERIALS

# A GUIDE FOR COLLECTORS AND PROCESSORS

Materials to be discussed include:

- › Paper
- › Plastic
- › Aluminum cans
- › Steel cans
- › Glass containers

## **GENERAL GUIDELINES FOR AVOIDING CONTAMINATION IN RECYCLING**

This guide supplies generic quality control and specification requirements for recovered recyclable commodities. A list of sources for markets by commodity and specific requirements for paper, plastics, aluminum cans, steel, and glass containers are also described.

With any recyclable material, be sure to discuss product specifications with your end-market. If you are working in a cooperative venture with other collectors of recyclables, be sure all parties agree to meet the specifications of the end-user. See Guide pages on individual materials for specific collection guidelines.

In general, contamination increases with the increase in material collected for recycling. Even if correctable, contamination that reaches an end-user can lead to higher costs, slower production and reduced yields. The easiest time to pick out contaminants is before they mix with other sorted and uncontaminated recyclables already in storage.

## **INSPECTION, HANDLING, AND STORAGE**

- › Inspect thoroughly before adding newly collected recyclables to stored material.
- › Remove contaminants.
- › Notify source to prevent re-occurring contamination.
- › Reject questionable materials.
- › Utilize public education; clear signage and staff members at roll-offs and other drop sites to avoid confusion about acceptable and non-acceptable materials.
- › Store and ship materials in clean containers.
- › Use proper equipment to increase efficiency.
- › Allow adequate space for storage of materials.
- › Security may be an additional factor.

## **TRANSPORTATION**

- › Sweep and inspect trucks prior to loading materials
- › Inspect material while loading.
- › Check with your end-user to determine if a material needs to be densified, baled or otherwise prepared to be accepted.

- › Check on transportation arrangements, such as possible backhauling, with your end-user or transportation company. Rates may be affected by the degree of processing that your material has undergone.

## SOURCES OF MARKET INFORMATION

<b>ALL MATERIALS</b>	Resource Recycling P.O. Box 42270 Portland, OR 97242-0270 503-233-1305 <a href="http://www.resource-recycling.com">www.resource-recycling.com</a>	Recycling Today 4012 Bridge Ave Cleveland, OH 44113 800-456-0707, ext 218 <a href="http://www.Recyclingtoday.com">www.Recyclingtoday.com</a>	Recycling Markets Limited Your Online Recycling Database 877-825-6555 <a href="http://www.recyclingmarkets.net/index/html">www.recyclingmarkets.net/index/html</a>
<b>PAPER</b>	RISI 4 Alfred Circle Bedford, MA 01730 866-271-8525 <a href="http://www.risi.com">www.risi.com</a>	American Forest & Paper Assoc. 1101 K St Washington, DC 20005 800-878-8878 <a href="http://www.afandpa.org">www.afandpa.org</a>	
<b>PLASTICS</b>	The Association of Post Consumer Plastics Recyclers ( <b>APR</b> ) 1001 G Street NW, Suite 500 W Washington, DC 20001 202-316-3046 <a href="http://www.plasticsrecycling.org">www.plasticsrecycling.org</a>	National Association for Plastic Container Recovery ( <b>NAPCOR</b> ) Post Consumer PET Plastic Market List 7310 Turfway Rd., Suite 550 Florence, KY 41042 859-372-6635 <a href="http://www.napcor.com">www.napcor.com</a>	
<b>GLASS CONTAINERS</b>	Glass Packaging Institute 100 N. Fairfax St., Suite 301A Alexandria, VA 22314 <a href="http://www.gpi.org">www.gpi.org</a>		
<b>METALS</b>	Steel Recycling Institute Eastern Region Office 57 Newport St. Cantonment, FL 32533 850-479-7208 <a href="http://www.recycle-steel.org">www.recycle-steel.org</a>	Institute of Scrap Recycling Industries ( <b>ISRI</b> ) 1615 L Street NW, Suite 600 Washington, DC 20036-5610 <a href="http://www.isri.org">www.isri.org</a>	



**PAPER**

## QUALITY CONTROL AND MARKET CONSIDERATIONS

## MANUFACTURING PROCESS

Paper is originally made from highly compressed and heated cellulose fibers from young, tender soft woods, specifically grown and harvested as “paper pulp trees.” There are more than 90 grades of paper in various categories: packaging, newsprint, office grade, tissue grade, magazines, boxboards and corrugated containers. The grade is determined by the quality of the fibers, as well as by the level of contaminants found. Longer fibers and cleaner paper result in higher grades and higher potential market value.

## USE OF RECYCLED FEEDSTOCK VS. RAW MATERIALS

Recycling paper is an industrial process using a higher grade of clean waste paper to contribute to the production of a lower grade.

**Recovered materials** – Today wood wastes and recovered paper provides more than 60% of the industry’s fiber; pulpwood supplies the rest. Raw materials and recycled feedstock go through a digester, grinders, refiners or re-pulper to release the fibers that are then screened and cleaned of debris. Some fibers require bleaching. Tailored and blended to meet the end-use requirement, the fibers are formed at high speed into a mat and compressed between rollers to the required thickness. On-line sensors monitor the process for quality.

Paper and paperboard rolls are cut, trimmed and packaged into smaller rolls or sheets for shipment for converting into consumer packaging or products.

The 2001 national recovery rate for paper was 48.3%. The four major categories of waste paper generally collected for recycling are:

- › **Old Newspapers** - - 8.8 million tons or 71% of U.S. consumption are recycled annually. In 2001, newspaper was 4.0% by weight and 3.5% by volume of municipal solid waste after recycling. Approximately 100 lbs. per person of newsprint is generated each year.
- › **Old Corrugated Containers (OCC)**- - 74% national recovery rate; 65% average recycled content. In 2001, old corrugated containers accounted for 13% by weight and 8.1% by volume of municipal solid waste. In 2001 over 250 lbs. of OCC were produced for every American.
- › **Office Paper** - - fine grades of paper including white ledger and sorted office fiber (SOF). About 48% of office paper produced is recovered for recycling.
- › **Mixed Paper** - - Unsorted household and commercial paper, magazines and various packaging waste. The lowest grade of waste paper, both in terms of quality and selling prices, mixed paper faces increasingly improved markets due to advances in paper mill technology.

All four categories can be broken down into numerous, more distinct sub-grades.

## **CONTAMINANTS TO AVOID FOR ALL GRADES**

Consult your individual paper markets for each one's definition of allowable types and quantities of contaminants. In collecting all grades, contaminants to be avoided generally include:

- › Rubber bands.
- › Metal or plastic clips (staples may be acceptable).
- › Waxed paper containers, such as milk cartons or produce boxes.
- › Plastic bags.

## **HANDLING/CONTAMINATION CONSIDERATIONS BY GRADE**

### **Old Newspapers (ONP)**

- › Keep newspapers clean and dry.
- › Store loose in "Gaylord" type boxes (4 foot square and tall heavy corrugated boxes).
- › Do not commingle ONP with other recyclables, especially glass or metals, unless program allows total commingling.
- › Magazines and telephone books are not always accepted because they contain contaminants such as glues that must be trimmed and discarded before processing.

Additionally, some recycling centers or markets require:

- › Removal of any glossy ad inserts or magazine sections;
- › Specific packaging instructions that rule out shipping loose or boxed.

Old newspapers are used to make newsprint cellulose insulation, boxboard, cat litter, roofing felts, toweling, packing material, egg cartons, animal bedding, and mulch.

### **Old Corrugated Containers (OCC)**

In the past, OCC markets have accepted brown paper grocery bags and kraft paper mixed with corrugated. Current buyers generally expect an OCC bale or bundle to consist of 70% or more old corrugated containers. Check specifications carefully.

- › Avoid dark colored medium (the fluted sheet between the flat liners); it may be specially treated and not be acceptable to the consuming paper mill.
- › Bale if at all possible. Densify in a compactor if your market is nearby and will accept it that way. Break down and flatten boxes to ship loose if there is no other option. Typical weight is 25-30 lbs. per cubic foot if baled, 6-8 lbs. per cubic foot compacted and 2-4 lbs. per cubic foot if loose.
- › Keep post-industrial scrap separate by grade to maintain highest recycling value.

OCC is used in linerboard, corrugating medium and recycled paperboard.

### **Office Papers (High Grade/Deink)**

Generally these include those papers found in the office: white typing, writing and

photocopy (xerographic) paper; computer printouts; white index cards; and tabulating cards. All types can be mixed together, but generally, the better the separation, the higher the grade and the better the price. This grade is called Sorted Office Fiber (SOF), Sorted Office Paper (SOP), Mixed Office Waste (MOW) and Sorted Office Waste (SOW), depending on which mill uses it.

Some types of paper cannot be included with office paper. These include:

- › Carbon paper.
- › Peel off stickers and the backing paper.
- › Envelopes with adhesive labels.
- › Thermal FAX paper blueprints.
- › Film, photographs, cellophane tape or glue.

Your buyer may require:

- › A sort by color, white separate from all other colors;
- › Exclusion of certain materials: thermal paper, carbon paper, blueprints, etc.;
- › Exclusion of old newspapers or ground wood business forms (lignin detector chemical pens are used to show the difference – ask your broker/dealer about it).

Other common non-paper contaminants in office papers:

- › Large metal fasteners (paper clips are acceptable).
- › Medical wastes.
- › Lunch bags, food wastes, smoking materials and Styrofoam cups.
- › Floor sweepings, restroom wastes.

Along with cuttings from paper converting plants, recycled office papers are used make tissue and printing/writing papers, substituted directly for wood pulp.

## **Mixed Paper**

In recent years, mixed paper has become a more specialized category. More paper mills are using mixed paper as a substitute extender or filler for more expensive grades. This trend has caused mixed paper to become a more reliably marketable grade of waste paper. You must be in agreement with your buyer on what papers can and cannot be included into your “pack”. Mixed paper is sub-categorized by:

- › “Hard Mix” – majority of the papers are kraft or other chemical pulp (sulphate/sulfite) business paper
- › “Soft Mix” – majority of the papers are ONP or other ground wood papers.

For more information on paper markets, request: “*Paper Matcher: A directory of Paper Recycling Resources*” from:

**American Forest and Paper Association**  
1250 Connecticut Ave., NW, Suite 360  
Washington, DC 20036  
800-878-8878



## PLASTICS

### QUALITY CONTROL AND MARKET CONSIDERATIONS

#### MANUFACTURING PROCESS

Plastics are made up of building blocks called “hydrocarbons” derived from petroleum or natural gas. These monomers (small molecules) are chemically bonded into chains called polymers or plastic resins. Resins are heated to their particular melting point and then blown or injected into molds, extruded or pelletized to form a final product. Different combinations of monomers yield resins with special properties and characteristics. For example, polyethylene terephthalate (PET) is used in soda bottles because it holds in carbonation. Polystyrene insulates and resists deforming if a hot substance is poured into it, making it ideal for food and beverage containers. PVC is preferred for red meat storage, since the film is semi-permeable, allowing in oxygen to keep the meat red, but still keeping in the meat’s juices.

A voluntary number coding system identifies resins used in plastic packaging; a special mark is placed on the bottom of plastic bottles 16 ounces and larger, plastic containers 8 ounces and larger and some plastic bags.

- 1 **PETE** (polyethylene terephthalate) is used in soft drink, most water bottles, cooking oil, liquor bottles, and peanut butter jars.
- 2 **HDPE** (high density polyethylene) is used in milk, juice and laundry product bottles. Many plastic grocery bags are HDPE as well.
- 3 **V** (polyvinyl chloride, commonly called vinyl, or PVC) is used in bottles for cooking oil, water, health and beauty aids, and household chemicals, as well as in film wrap for meat packaging.
- 4 **LDPE** (low density polyethylene) is used in film products, such as stretch wrap and some grocery bags, or in flexible tubs for products such as ice cream or margarine.
- 5 **PP** (polypropylene) is used in yogurt cups and ketchup bottles.
- 6 **PS** (polystyrene) is a rigid plastic that can be clear, as in salad containers, or foamed for food service containers, such as meat trays, egg cartons, etc. (Styrofoam)
- 7 **“Other”** assorted resins are used in about 3% of plastic packaging.

Thirty-nine states, including Kentucky, now require that plastic bottles be coded by resin type. The existence of a code category does not imply recyclability or the existence of a

market for the material. It does specify the single resin that the container is made from.

95% of all plastic bottles and jugs are either PET or HDPE. The remaining 5% is a mixture of the remaining resins.

## **USE OF RECYCLED FEEDSTOCK VS. RAW MATERIALS**

In a typical recycling process for plastic containers, the containers are separated by resin type and color, then chopped, washed and converted to flake or pellets. This material is then remelted – with or without virgin resin – and reformed or in the case of PET or polyester, can also be “spun” into a fiber. Polymers within the same family may be blended, but only in limited percentages. Because different resins have different melting temperatures, polymers from different families will not bond to one another and may degrade each other.

For example, if a manufacturer is making a bottle or pellet out of PET flake, the material is generally processed at about 280 degrees Fahrenheit. PVC melts at between 150 and 220 degrees. At 230 degrees, it starts to burn and turns black. Therefore, any recycled PET product that contains PVC will have black chars in it, or, at the very least, will appear yellow in color, instead of clear, because the PVC has burned. On the other hand, if you’re making a recycled PVC product that is contaminated with PET, the PVC product will have chunks of unmelted PET in it, because the temperature never got high enough to melt the PVC.

Mixing blow-molded plastic HDPE milk jugs with injection-molded plastics found in butter tubs and yogurt containers can also create problems in recycling, since the two manufacturing processes require different fluidity levels for the same type of plastics.

Two processes used to recycle post-consumer PET for use in food grade packaging are glycolysis and methanolysis. These processes break down post-consumer PET into its molecular building blocks (called naphthalene) and rebuild the polymer chains, ensuring pure recycled resin. In 1991, repolymerized PET was introduced in soft drink and salad dressing bottles sold in a few U.S. regions. Some non-food containers such as Spic-n-Span bottles are 100% post-consumer PET and do not have to go through this process. Single serve soft drink bottles of less than 16 ounces have been introduced which contain some recycled content and barrier layers of non-PET plastics to retain product freshness. It remains to be determined if the barrier material adversely effects the recycling of PET.

## **PREPARING PLASTICS FOR RECYCLING**

- › Remove all caps. Plastic cap may not be same resin as container.
- › Rinse/drain to eliminate residue.
- › Crush to reduce volume.
- › CHECK LOCAL REQUIREMENTS. Some recyclers and markets require that labels be removed or certain colors be sorted out.

## **CONTAMINATIONS**

- › Plastics of different resin types mixed together - - discard any caps, rings and labels made by non-compatible plastic resin.
- › Metal container caps and neck rings.
- › Dirt, stones, wood, grease, glass, paper, excess moisture, and rust.

### **COLLECTIONS, HANDLING, AND SHIPPING**

- › Ultraviolet light from the sun degrades plastic. Store material under UV protective cover; i.e. inside buildings or under tarps.
- › An average PET bale weighs between 700-1000 lbs. The Institute of Scrap Recycling Industries recommends minimum bale density of 10 lbs. per cubic foot. Maximum density should be determined by individual sales contract.
- › Choose non-rusting and non-corroding material for bale wires (galvanized wire is preferred), ties or straps.
- › Distorted or broken bales may result in downgrading or rejection.

For more information, request “*Publications and Materials Order Form*” from:

**American Plastics Council**  
 1275 K Street, NW, Suite 400  
 Washington, DC 2005  
 202-371-5256

Also, request the “*Post-Consumer PET Plastic Market List*” from:

**National Association for Plastic Container Recovery (NAPCOR)**  
 3770 Nations Bank Corporate Center  
 100 North Tryon Street  
 Charlotte, NC 28202  
 704-358-8882

### **PRODUCTS MADE FROM RECYCLED PLASITCS**

**PETE - #1**

Fibers (polyester)– carpets, rope, apparel, filters  
 Textiles – belts, sails, tire cord  
 Strapping  
 Scouring pads  
 Fence posts  
 Non-food bottles  
 Industrial paints  
 Geo-textiles

Polyol for automobile bumpers

Unsaturated polyester can be used in bathtubs, sinks, boat hulls, and awnings

### **HDPE - #2**

Detergent bottles, motor oil bottles

Waterproof “plastic lumber”, pallets, railroad cross ties.

Flowerpots

Drainage pipe

Trash cans

Traffic barrier cones, signs

Animal pens

### **Polystyrene - #6**

Plastic lumber

Building insulation

Packing materials

Reusable cafeteria trays, tobacco seedling “floats” trays

### **Vinyl (PVC) - #3**

Drainage, sewer, water and irrigation pipe

Pipe fittings, and electrical conduit

Handrails, fencing

Downspouts, house siding



**STEEL**

## **QUALITY CONTROL AND MARKET CONSIDERATIONS**

### **MANUFACTURING PROCESS**

Iron ore, coke and limestone are heated and combined as a molten metal. With the use of oxygen or electricity, scrap steel is melted and added to the raw material

mixture in an exothermic reaction. The steel is then cast into slabs, which can be made into a number of products.

## USE OF RECYCLED FEEDSTOCK VS. RAW MATERIAL

Scrap steel is needed metallurgically and economically to make new steel. Post-consumer scrap comes from food, beverage, paint and aerosol spray cans, lids and closures, as well as used appliances, vehicles and building materials.

Major integrated mills use 20 to 30 percent scrap in the basic oxygen furnace. Mini-mills using **electric arc furnaces** use virtually 100% scrap for raw materials. Mini-mills account for 40% of all steel production nationally.

The national recycling rate for all steel products is 66%. The 2000 recycling rate for steel food and beverage cans was 58%. Tin recovered from tin-coated cans is a premium quality grade material used for many applications. Steel cans constitute 1.3% by weight and 1.8% by volume of municipal solid waste. The average American uses 142 steel cans per year.

## PREPARING AND PROCESSING STEEL FOR RECYCLING

- › Rinse cans to remove food and other debris.
- › Use magnet or manually separate bimetal beverage cans and steel food cans from all-aluminum cans for separate recycling. Market may also require separation of bimetal cans from all steel cans.
- › Crush or bale for delivery to the detinner or mill
- › CHECK LOCAL REQUIREMENTS. Some recyclers and markets require food cans to be separated from other ferrous metal, while some allow food cans to be mixed with other ferrous metal.

Some markets accept empty steel aerosol and paint cans. Check with market before collecting these items. To prepare them for recycling:

- › Empty aerosol can completely through normal use. If it has a plastic lid, remove it. Spray nozzle does not need to be removed.
- › Empty steel paint cans and make sure only a very thin, dry skin of paint is left on the sides and bottom of a can. The steel lid of a can of paint can be recycled, but it should be left off the can and placed separately in recycling bin.

**The Steel Recycling Institute** can provide more information regarding adding empty paint and aerosol cans to recycling programs.

## CONTAMINANTS

- › Food and other debris left in the container.
- › Nonmagnetic metals, except those used in can construction, such as aluminum lids on bi-metal beverage cans.
- › Any nonmetallic materials such as water, oil, plastic, wood debris, etc.

## COLLECTION, HANDLING, AND SHIPPING

- › To save storage/transportation space, compact cans either individually or in bales. The Steel Recycling Institute recommends that bales or densified biscuits of can scrap for steel companies have a density of 75 to 80 lbs. per cubic foot. Bundle weight is subject to negotiation.
- › Baled scrap for detinning companies should have a nominal density of 30 lbs. per cubic foot, subject to individual sales agreement.
- › Wire or steel banding is acceptable.
- › Loose cans (whole or flattened) and shredded cans (loose or baled) are acceptable, subject to negotiation.

For more information on steel markets contact:

**Steel Recycling Institute**  
Foster Plaza X  
680 Andersen Drive  
Pittsburgh, PA 15220  
800-876-SCRI (7274)



## ALUMINUM

### QUALITY CONTROL AND MARKET CONSIDERATIONS

#### MANUFACTURING PROCESS

Most aluminum is made from bauxite, a clay-like ore. A refining process removes impurities from bauxite, leaving a pure intermediate ore called alumina – aluminum oxide. The tightly bound alumina molecule is broken apart by a powerful electric current in the smelting process, resulting in molten aluminum. The molten metal is alloyed with other elements and cast into solid ingots.

In a rolling mill, a 21-inch thick ingot can be rolled out to a ½ - inch slab. In two additional rolling stages, the slab is reduced to sheet metal a few thousandths of an inch thick. The sheets are coiled into spools, trimmed to a specific width, cleaned, leveled, lubricated – and possibly coated for end-stock before being shipped to a can manufacturer.

## **USE OF RECYCLED FEEDSTOCK VS. RAW MATERIALS**

Used aluminum beverage cans return to the can-making loop when they are melted down at an aluminum plant. Getting aluminum in this way is 95% more energy-efficient than smelting bauxite ore.

Recycling not only saves energy, it also conserves capital and raw materials. An industrial facility to melt used aluminum cans may be built in half the time and at one-tenth the cost of the facilities to mine and refine ore to produce aluminum.

The U.S. aluminum industry recycled 67.9% of the cans it produced in 1992. This has since fallen to less than 55% in 2000. Today's aluminum beverage can is composed of approximately 52% post consumer recycled content. Aluminum packaging was 0.8% of land filled municipal solid waste by volume in 2000. The average American uses 365 aluminum cans or 12.5 pounds per year.

## **PREPARING ALUMINUM FOR RECYCLING**

- › Separate all aluminum cans from bi-metal cans with a magnet. The magnet will stick to the cans containing ferrous metals.
- › Flatten cans to save space in storage and transportation. A large garbage bag of unflattened cans weighs about 7 lbs. The same bag with flattened cans weighs about 18 lbs. About 30 all-aluminum cans will weigh 1 lb.
- › Formed containers such as frozen entrees, bakery items and deli trays should be sorted and densified separately from cans. Rinse off any food residues, remove paper or plastic labels and flatten for storage.
- › Some pet-food, tuna and specialty meat containers are made from the same aluminum alloy as beverage containers. Look for "100% aluminum" on the containers.
- › CHECK LOCAL REQUIREMENTS. Most recycling centers and markets require that aluminum cans to be separated from aluminum foil, pie plates, scrap aluminum such as siding, gutters, storm doors, window frames and lawn-chair tubing. Be sure these other items are accepted before you collect them.

## **CONTAMINANTS**

- › Metals such as iron, steel, copper, lead, brass
- › Plastics (can ignite during processing)
- › Multi-layered foil used in some flexible food packaging, such as foil-backed paper, which cannot be easily separated into its recyclable components
- › Liquids left in beverage containers, cigarette butts
- › Dirt, dust, sand, glass
- › Dangerous items such as: ammunition, explosives, hazardous materials bags,

needles/syringes, and weighted cans.

## **INSPECTION, HANDLING AND SHIPPING**

- › Tumble cans in wire baskets or screens to eliminate moisture.
- › Place cans on pallets when storing.
- › Store cans under cover away from moisture, wind, and dirt.
- › Used aluminum cans can be shredded, densified and baled or shipped loose and flattened.
- › A typical bale should be 14 to 22 lbs. per cubic foot. Minimum bale size is 30 cubic feet. Bale range dimensions acceptable are 24 to 40 in. x 30 to 52 in. x 40 to 72 in.
- › Densified bundle density should be 35 to 45 lbs. per cubic foot. Each bundle shall have banding slots in both directions to facilitate bundle banding. Optimum dimensions are 12 in. x 12 in. x 12 in. Bundle range dimensions acceptable are 41 in. to 44 in. x 51 in. to 54 in. to 56 in. (height).
- › Shredded density should be 12 to 17 lbs per cubic foot. Material should contain maximum 5 percent fines less than 4 mesh (US standard screen size) and no more than 2.5 percent fines less than 12 mesh (US standard screen size).

For more information on aluminum markets contact:

**Aluminum Association**  
900 19<sup>th</sup> Street, NW, Suite 300  
Washington, DC 2006  
202-862-5100



## **QUALITY CONTROL AND MARKET CONSIDERATIONS**

### **MANUFACTURING PROCESS**

Glass bottles and jars are comprised of sand, soda ash and limestone. These minerals are mixed together and melted in a glass furnace at around 2,800 degrees Fahrenheit. The molten mixture is molded and blown into container shapes, then carefully cooled in an annealing oven to toughen the containers against breakage. After inspection, the containers are shipped to food and beverage makers.

Different colors of glass are manufactured to provide protection for the products that are packaged within them. Green and brown containers, for example, screen out ultraviolet light and maintain the freshness of certain foods or beverages. Different colors of glass are produced during the furnace “batching,” a process that must be carefully controlled, since the color will be part of the permanent, chemical composition of the glass. If different colors of glass are melted together, their chemical coloring agents can react violently with

each other. This is why color-separation is a major quality control issue in collecting glass containers for recycling back into containers.

Seventy percent of all glass containers manufactured in the United States are clear, or “flint,” with the remainder split between green and brown. The different colors are produced at different locations, and sometimes, during varying periods of the year, at those plants where more than one color is produced.

## **USE OF RECYCLED FEEDSTOCK VS. RAW MATERIALS**

Glass containers are 100 percent recyclable. This includes beverage bottles, juice containers, condiment bottles (ketchup, mustard, pickles, etc.), wine and liquor bottles and food containers. Crushed used glass, or “cullet” can be substituted for some or all of the raw materials mentioned above. Because cullet has already been through a previous heating, it melts at a lower temperature than that required to melt raw materials alone. Substituting cullet for raw materials therefore saves natural resources and energy needed to heat a furnace, while extending the useful life of the furnace. At present, the only feedstock used in greater quantity than cullet is sand.

In 2000, 26% of all glass containers available on the U.S. market were recovered. On national average, each container has 30% recycled content. In 2000, glass containers constituted approximately 5% by weight and 1% by volume of municipal solid waste. The average American uses 176 glass containers or approximately 88 lbs. per year.

## **PREPARING GLASS FOR RECYCLING**

- › Remove all metal – lids, caps, neck rings.
- › Rinse and drain thoroughly.
- › Separate and store by color: clear (flint), green and brown (amber).
- › Labels can remain on containers.
- › Clean off any dirt and remove any stones.
- › Broken containers may be acceptable, providing fragments are not crushed too small, generally under 2” square. Pieces must be separated by the proper color category. A Gaylord type box of whole bottles and jars weighs about 900 lbs. A Gaylord of crushed glass usually weighs 2000 lbs. or more. Make sure the container can be lifted by a pallet jack or forklift and is able to pass through outside doorways.

## **CONTAMINANTS**

- › Metal neck rings, lids and caps
- › Non-container glass or ceramics such as:
  - Plate glass, window glass and mirrors
  - Pyrex or other heat-resistant glass
  - Light bulbs
  - Lead-based glass, such as crystal, TV and computer monitor tubes
  - Ceramic cups, dishes and ovenware
  - Automotive glass

- Milk-white glass
- Household drinking glasses
- Clay flowerpots
- Color-mixed glass

## **INSPECTION, HANDLING AND SHIPPING**

- Containers will usually break sufficiently with handling to allow for economic transport. Crushing containers does not add to their value as cullet, but will economize on shipping costs. Glass ground to a powder may be suspected of hiding contaminants and will probably be rejected. Check with end-market before crushing any glass.
- If stored outside, cullet should be placed on a concrete pad, not on ground or asphalt, to avoid pick-up of dirt or gravel during loading.
- Cover cullet during cold, wet weather.
- Cullet may be delivered in Gaylord boxes, truckload or railcars. Check with end-market to determine required method.

The use of glass for containers has steadily eroded over the last 10 years as plastic has become more widespread. Glass manufacturing and need for glass cullet has sharply fallen and with it the prices paid to the recycler. In most cases glass is currently marketed at negative prices, often making glass recycling more expensive than landfill costs.

One alternative market for glass has been developed by several states, including Kentucky. **Pulverized Glass Aggregate (PGA)** is added to densified gravel aggregate for roadbed construction. This use eliminates the need to color sort and pay transportation fees for shipping to cullet processors. Other types of glass as well as ceramics, and porcelain may be included as well. Leaded glass, such as automotive windshields, TV and computer monitor leaded glass **must be avoided**.

For more information on glass markets contact:

**The Glass Packaging Institute**  
1627 K Street, NW, STE 500  
Washington, D.C. 20006

Or

**Kentucky Division of Waste Management**  
300 Sower Boulevard, 2nd Floor  
Frankfort, KY 40601  
Phone: 502-564-6716 Fax: 502-564-4245  
Telecommunications device for the deaf/hard-of-hearing: 502-564-0172  
E-mail: [waste@ky.gov](mailto:waste@ky.gov) Web site: <http://www.waste.ky.gov/>



## SECTION 7

# CONVERSION TABLE FOR RECYCLABLE MATERIALS

MATERIALS	VOLUME	WEIGHT (LBS)*
<b>PAPER</b>		
Corrugated Cardboard, loose	One cubic yard	300
Corrugated Cardboard, baled	One cubic yard	1,100
Corrugated Cardboard, baled	30"x 60" x 48"	900
Newsprint, loose	One cubic yard	580
Newsprint, compacted	One cubic yard	860
Newsprint	12" stack	35
Magazine, stacked	One cubic yard	1,215
Magazine, loose	One cubic yard	950

High Grad/Office paper High Grade/Office paper	40" x 48" x 40" One cubic yard	650 400
Mixed Grades/Junk Mail, loose	One cubic yard	875
Phone Books	12" stack	25
<b>METAL</b>		
Aluminum Food or Beverage Containers, Whole Aluminum Food or Beverage Containers, flattened	One cubic yard One cubic yard	62 250
Steel/Tin Cans, whole Steel/Tin Cans, flattened	One cubic yard One cubic yard	150 850
<b>GLASS</b>		
Whole bottles Whole bottles Semi-crushed Crushed (mechanically) Uncrushed to manually broken	One cubic yard Full grocery bag One cubic yard One cubic yard 55 gallon drum	800 15 1,400 1,750 350
<b>MATERIALS</b>		
<b>VOLUME</b>		<b>WEIGHT (LBS)*</b>
<b>PLASTIC</b>		
Film Plastic, baled Film Plastic, baled	30" x 42" x 48" Semi-trailer load	1,100 44,000
Mixed PET & dairy, whole, loose Mixed PET, dairy & other rigid, whole, loose Mixed rigid, no film or dairy, whole, loose Mixed rigid, no film, granulated Mixed rigid & film, densified by mixed plastic mold technology	One cubic yard One cubic yard One cubic yard Gaylord** One cubic foot	Average 30 Average 40 Average 50 750 Average 60
<b>ORGANICS</b>		
Yard Waste, raw, uncompacted (either for composting or land application) Yard waste, finished compost	One cubic yard One cubic yard	350 1,400
Food Waste, pasteurized and prepared for animal feed	32 Gallons	170
<b>MISCELLANEOUS</b>		
Household Batteries, miscellaneous grades  Mixed Textiles, loose Mixed Textiles, baled Mixed Textiles, baled  Household Hazardous Waste	55 gallon drum  One cubic yard One cubic yard 31" x 45" x 60"  One gallon	600  240 480 885  10

Used Major Appliances (average of all types and brands)	One appliance	200
Motor Vehicle Batteries	One battery	36
Used Motor Oil	One gallon	8
Tire	One passenger tire	20
Tire	One truck tire	60
<b>MIXED MUNICIPAL SOLID WASTE (MSW)</b>		
MSW, compacted in packer truck	One cubic yard	620
MSW, compacted in-place at land disposal facility	One cubic yard	800

\*Divide pounds by 2,000 to calculate tons  
 \*\* Gaylord size most commonly use is 40"x 48" x 36"

One cubic yard = 36" x 36" x 36" or 46,646 cubic inches  
 One cubic yard = 202 gallons  
 18 bushel hamper = 0.83 cubic yards

**SOURCES:**

National Recycling Coalition Measurement Standards and Reporting Guidelines

## GLOSSARY OF RECYCLING TERMS

**Coding** – In the context of solid waste, coding refers to a system to identify recyclable materials. For example, the coding system for plastic packaging utilizes the “three chasing arrows” with a number in the center and letters underneath. The numbers and letters indicate the resin from which each container is made:

- 1 = PETE (polyethylene teraphthalate)
- 2 = HDPE (high density polyethylene)
- 3 = V (vinyl)
- 4 = LDPE (low density polyethylene)
- 5 = PP (polypropylene)
- 6 = PS (polystyrene)
- 7 = Other/mixed plastics

This code is designed to help sort for recycling.

**Collection** – The act of obtaining used materials from residential and business sources and hauling them to a facility for processing.

**Composite Packaging** – In the simplest sense, any type of packaging constructed of more than one material. Also may include some packages composed of multi-layered material.

**Contaminant** – Any substance that causes other substances to be unfit for use by the introduction of unwholesome or undesired elements. For example, ceramic is a contaminant to be avoided when recycling glass.

**Cullet** – Furnace-ready, crushed glass, usually added to new raw material to facilitate melting when making glass.

**Densify** – To reduce recyclables' volume, by compacting, crushing, baling or other means. Allows for more efficient storage and transportation.

**Detinning** – The process of removing the thin coating of tin on steel food cans. This process can be done optionally; prior to steel can scrap being recycled.

**End User** – Mills and other industrial facilities where secondary materials are converted into new materials. Examples include paper mills, steel mills, detinners and glass manufacturing plants.

**Feedstock** – A processed material used in manufacturing. Also called “furnish” for paper mills.

**Ferrous Metal** – Metal containing iron. Ferrous metals, such as steel, will stick to a magnet.

**Generator** – An individual, company, organization or activity that produces wastes or secondary materials.

**Market** – (1) A firm or operation purchasing secondary materials. (2) The available supply of or demand for goods containing recycled materials. **Intermediary Market** – Scrap dealer, recycling operation and /or processor that purchase secondary materials from collectors for sale to an end user.

**Materials Recovery** – A mechanical or labor-intensive process that separates out reusable and recyclable materials such as plastics, metals, glass and certain grades of paper for the purpose of beneficial reuse.

**Mill Scrap** – Material generated during primary material manufacturing that is often reused at the point of generation. Also called, “Post-industrial Waste”.

**Non-Ferrous Metal** – Metal that does not contain iron, such as aluminum, copper, zinc.

**Office Paper** – Used paper generated by offices, including stationery and copy paper.

**Post-consumer Waste** – Materials generated by the final consumer (residential or non-residential) after it has served its intended use and has been collected for reuse or recycling. The term does not include those materials and by-products generated from and commonly used within an original manufacturing process.

**Primary Material** – Virgin or new material used for manufacturing basic products.

**Processor** – A part of the recycling business cycle where operators store, grade, clean, densify or package secondary materials for sale to an end user.

**Raw Material** - An unprocessed natural resource, a processed secondary material or a product used in manufacturing.

**Reclamation** – The process of restoring material found in the waste stream to usefulness or productivity. Reclaimed materials may be used for purposes different from their original use.

**Reduction** - see **Waste Reduction**.

**Recyclable** – The technical ability of a material to be reused in manufacture.

**Recycled Content** – Percentage of recycled material used to manufacture a product.

**Recycling** – The diversion of materials from the solid waste stream and the beneficial reuse of such materials. Recycling is further defined as the result of a series of activities by which materials that would become or otherwise remain waste are diverted from the waste stream for collection, separation and processing. These materials are used as raw materials or feedstock in lieu of or in addition to virgin materials in the manufacture of goods sold or distributed in commerce or the reuse of such materials as

substitute for goods made from virgin materials.

**Roll-off** – A bulk container for holding waste materials. Small roll-offs are picked up and emptied into a waste disposal truck; large ones are mechanically pulled into a roll-off bin truck, trailer or transfer trailer.

**Secondary Materials** – All types of materials handled by dealers and brokers that have fulfilled their original function and usually cannot be reused in their present form or at their present location. Also includes materials that occur as waste from manufacturing or conversion of products.

**Separation** – Sorting material by its physical properties, including color, luster, size, shape or other surface characteristics.

**Shred** – To cut or tear into long narrow strips. Cans and paper are often shredded.

**Solid Waste Stream** – The total flow of solid waste from homes, businesses, institutions and manufacturing plants.

**Virgin Materials** – Any basic materials for industrial processing or manufacturing that have not been previously used.

**Waste Reduction** – Products or policies that reduce the amount of waste that must be disposed in landfills, incinerators or waste-to-energy facilities.

## NEED MORE HELP?

We hope this guide has given you a solid foundation for developing a community-based recycling program. As the program develops, you may have questions about properly managing its growth and linking it to other local recycling initiatives. The Kentucky Recycling Market Assistance Program is experienced in providing onsite assistance in these and other technical areas. Best of all, our onsite consultation and marketing assistance is free. To learn more about our services, browse our website at <http://waste.ky.gov/RLA/recycling/Pages/recycling.aspx> or contact us at:

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